A Worksite Social & Physical Environmental Health Program

Coffeng, J.K.

2014

document version
Publisher's PDF, also known as Version of record

8

THE EFFECTIVENESS OF A COMBINED SOCIAL AND PHYSICAL ENVIRONMENTAL INTERVENTION ON NEED FOR RECOVERY IN OFFICE EMPLOYEES: RESULTS FROM A RANDOMISED CONTROLLED TRIAL

Coffeng JK, Boot CRL, Duijts SFA, Twisk JWR, Van Mechelen W & Hendriksen IJM.

Under review.



ABSTRACT

Objective: To investigate the effectiveness of a combined worksite social and physical environmental intervention in office workers on need for recovery (NFR), exhaustion, detachment, relaxation, small breaks, stair climbing, physical activity and sedentary behaviour. Also, the effectiveness of the separate interventions was investigated.

Methods: In this 2x2 factorial design study, 412 office employees of a financial service provider participated. Participants were allocated to the combined social and physical environmental intervention, to the social environmental intervention only, to the physical environmental intervention only or to the control group. Outcomes were measured by questionnaires at baseline, 6 and 12 months follow-up. Multilevel analyses were performed to investigate the effects of the three interventions.

Results: In all intervention groups, a non-significant reduction was found in NFR. In the combined environmental intervention group (n=92), exhaustion and vigorous physical activities decreased significantly, and small breaks at work and active commuting increased significantly compared to the control group. The social environmental intervention group (n=118) showed a significant reduction in exhaustion, sedentary behaviour at work and a significant increase in small breaks at work and leisure activities. In the physical environmental intervention group (n=96), stair climbing at work and active commuting significantly increased, and sedentary behaviour at work decreased significantly compared to the control group.

Conclusion: None of the interventions was effective in improving the NFR. It is recommended to adapt the current interventions and to investigate the effectiveness of the interventions in employees with a higher NFR.

BACKGROUND

Over 22% of European Union employees suffer from stress at work on a daily basis and the annual economic costs of work-related stress in Europe was estimated at 20 billion Euro (1). Employee's physical and mental health condition is characterized by the degree to which employees are able to recover from fatigue and stress at work (2). Results of the Netherlands working condition survey (3), based on a representative sample of the Dutch workforce, revealed that there has been a slight increase in the NFR over the years. NFR is described as the need to recuperate and unwind from work-induced effort and represents the short-term workload effects of a day at work (4). A high NFR has unfavourable consequences for the individual worker, such as a high blood pressure, sleeping problems and fatigue (5-8). It also predicts future sickness absence lasting fourteen or more working days, which may result in a financial burden for companies due to increased absenteeism (9).

In recent years, there has been an increasing interest in health-related interventions targeting the worksite, i.e., worksite health promotion programs (WHP programs) (1;10). Previous WHP programs mainly focused on improving physical activity and nutrition of employees (11-17), but so far inconclusive evidence of effectiveness was found on both physical activity (11) and nutrition (13;15). The meta-analysis of Hutchinson et al., (12) found most support for workplace physical activity and healthy nutrition promotion when motivation approaches were used such as motivational interviewing. To date, few studies investigated the effectiveness of a WHP program on improving the NFR. A study on the effectiveness of a worksite vitality program, consisting of visits of a personal vitality coach and weekly yoga sessions, showed that the intervention group lowered their NFR compared to the control group (18) at 6 months follow-up, but this was not sustained in the long-term.

In an effort to reduce the NFR, evidence has been found that physical activity is valuable in unwinding from work (19-22). In particular, engaging in physical activity results in lower work stress (23). When more time is spent on physical activity after work, the feeling of being recovered is heightened (19). Relaxation is another strategy that seems to be important for recovery. It has been shown that relaxation activities are related to increasing one's feeling of recovery (20;24-27). A way to achieve

relaxation is to disengage from work, which reverses the negative consequences of straining job demands and returns the employee to pre-stressor levels. It was shown that low levels of relaxation are associated with weaker health, emotional exhaustion, a high NFR and sleeping problems (24). In view of this, it is important that interventions will be developed that involve physical activity and relaxation to improve the NFR among office employees.

As previous research has shown that, besides changing individual health behaviour, both the social and physical environment are important in improving health and well-being (28-34), WHP programs should adopt a socio-ecological model when developing and evaluating interventions. Socio-ecological models focus on making changes to the individual (intrapersonal), social (interpersonal), physical and/or organizational environment. In the current study, a socio-ecological framed WHP program focussing on a combined social and physical environmental intervention was applied, aiming at physical activity and relaxation to improve the NFR in office employees. Based on elements of the Intervention Mapping protocol, the intervention program was developed in close cooperation with the employees of a financial service provider with mainly desk jobs. Resulting from a needs assessment (i.e., questionnaire on physical activity, relaxation and NFR, individual interviews and focus group interviews with the target population), key determinants of physical activity and relaxation were selected and, methods and strategies were selected to affect these determinants. This resulted in a social environmental intervention consisting of Group Motivational Interviewing (GMI), conducted by teamleaders, and a physical environmental intervention consisting of environmental modifications (e.g., providing a table tennis and sitting balls).

The objective of this study was to investigate the effectiveness of the combined social and physical environmental intervention at 6 and 12 months follow-up compared to a control intervention, as well as the effectiveness of the social environmental intervention and the physical environmental intervention separately, on NFR after work, exhaustion, detachment, relaxation at work and after work, small breaks at work, stair climbing at work, physical activity and sedentary behaviour at work. It was hypothesized that the combined intervention would be more effective than the separate interventions compared to the control group.

METHODS

Study population and study design

Data were used from the Be Active & Relax "Vitality in Practice" (VIP) project (35) conducted at a financial service provider. In September 2011, 1,182 office employees of a financial service provider received an invitation for the project. A total of 412 office employees (35% response rate) from 19 departments signed the informed consent form, completed the baseline questionnaire and were included in the Be Active & Relax project. All respondents met the inclusion criterion of not being on sick leave for more than four weeks. The participants received follow-up questionnaires at 6 months and 12 months.

The effectiveness of the interventions was investigated in a trial using a 2x2 factorial design. The two factors were the social environmental intervention and the physical environmental intervention, of which the social environmental intervention was randomised at department level and the physical environmental intervention was stratified on department level, i.e., one stratum with environmental modifications and the other stratum without environmental modifications. This resulted in four research groups: (1) combined social and physical environmental intervention group; (2) social environmental intervention group only; (3) physical environmental intervention group only; (4) no intervention (control group). Blinding of the participants and intervention providers for the social environmental intervention was impossible, although none of them had received information about our design involving three intervention groups. This study was approved by the Medical Ethics Committee of the VU University Medical Center, Amsterdam, the Netherlands. More details on the study design, methods and interventions of the Be Active & Relax project have been published elsewhere (35).

Social and physical environmental interventions

Social environmental intervention

GMI was delivered by the teamleaders after receiving a two-day training, which was given by a GMI-professional. The educated teamleaders conducted four GMI-sessions of 90 minutes each with the employees of their own team, within a period of 3,5

months (i.e., the first 3 sessions were conducted once every three weeks, the last session was after 2 months). The main aim of the sessions was to stimulate physical activity and relaxation, e.g., during GMI-session two, employees were asked to fill in a worksheet stating their goals and subsequent rewards for improving physical activity and relaxation. The GMI-sessions were supported by a web-based social media platform.

Physical environmental intervention

Vitality in Practice (VIP) zones were created: (1) the VIP Coffee Corner Zone – the coffee corner was modified by adding a bar with bar chairs, a large plant and a giant wall poster (a poster visualizing a relaxing environment, e.g., wood, water and mountains); (2) the VIP Open Office Zone – the office was modified by introducing exercise balls and curtains to divide desks in order to reduce background noise; (3) the VIP Meeting Zone – conference rooms were modified by placing a standing table and a giant wall poster (a poster visualizing a relaxing environment, e.g., wood, water and mountains); and (4) the VIP Hall Zone - table tennis tables were placed and lounge chairs were introduced in the hall for informal meetings. In addition, footsteps were placed on the floor in the entrance hall to promote stair walking.

Outcome measures

Need for recovery (NFR) was assessed using the NFR after Work scale (36). This scale consists of eleven dichotomous items (yes/no), representing short-term effects of a day at work, with questions like “I find it hard to relax at the end of a working day” and “When I get home, people should leave me alone for some time”. The NFR score is a percentage score (0 to 100) of positive answers of those participants providing data for at least 8 of the 11 items. The NFR has shown good internal consistency (α=0.87) and validity (36). Validity was studied by analysing the associations of NFR with psychosocial risk factors (e.g., emotional load and physical exertion) (36).

Exhaustion was measured by the OLdenburg Burnout Inventory (OLBI) consisting of eight items (e.g., “I can usually handle the amount of work well”) on a 4-point scale ranging from “totally agree” to “don’t agree” (37). The OLBI has shown good internal consistency (α=0.85) and reasonable validity in different occupational groups (i.e.,

health care workers experienced higher levels of exhaustion than white collar workers) (38).

Detachment and relaxation after work were assessed with the Recovery Experience Questionnaire, which was developed by Sonnentag et al. (24). The validation study of the Recovery Experience Questionnaire (24) resulted in four items measuring detachment (e.g., "I don't think about work at all") and four items measuring relaxation (e.g., "I use the time to relax"). In the present study, we were also interested in measuring detachment and relaxation during work. For this purpose, the scale was adapted to a within workday context, starting each item with "During a break at work…", instead of "During time after work…" as written in the original questionnaire of Sonnentag et al. (24). Each item was assessed on a 7-point scale, ranging from "never" to "always". The internal consistency and construct validity of these subscales were investigated in a validation study, which was performed alongside the present trial (39). Internal consistency of the 'at work' and 'after work' detachment and relaxation scales were considered to be good (Cronbach's alpha ranged from 0.87-0.94). Construct validity was assessed by analysing the associations with NFR, exhaustion and work engagement, and was considered to be moderate.

Small breaks at work were measured with a newly developed question. Participants were asked how often they engaged in small breaks during a usual workday, using the following question: "Besides your lunch break, how many small breaks (minimum 5 minutes) do you have during a usual workday?"

Stair climbing at work was also assessed by a newly developed question. Participants were asked how many times they took the stairs during a usual workday, using the question: "How often do you take the stairs at work during a usual workday?"

Physical activity (i.e., active commuting, leisure activities, sports and total minutes per week in light, moderate and vigorous physical activities) was assessed by the Short QUestionnaire to ASsess Health enhancing physical activity (SQUASH) (40). A previous study (40) reported an overall reproducibility of 0.58 (95%CI, 0.36-0.74), which is comparable to other physical activity questionnaires (41). Also, reasonable validity of the SQUASH was demonstrated against accelerometry (40). The SQUASH questionnaire measures habitual physical activity levels referring to a normal week in the past months of four physical activity domains, i.e., active commuting (walking

and cycling to and from work), physical activity at work, household activities, and leisure activities (walking, cycling, gardening, chores and sports). For each domain, employees were asked to report the frequency (i.e., times per week), duration of activities (i.e., in minutes), and self-reported intensity (i.e., light, moderate or vigorous). The leisure domain included information on sports, of which employees could report upon a maximum of four. Physical activity was expressed in minutes per week and total activity scores were calculated by multiplying the minutes per week by the actual MET score (i.e., metabolic equivalent, which is the ratio of work metabolic rate to a standard resting metabolic rate of 1.0) of the specific activity (MET/min/week). Information was obtained on light (range <4 MET), moderate (range 4-6.5 MET), and vigorous (>6.5 MET) intensity activities (42).

Sedentary behaviour at work refers to those activities at work that require a very low energy expenditure (≤1.5 MET) while sitting or reclining (43). To assess sedentary time at work, participants were asked to estimate the total amount of minutes spend at work on computer use, meetings and other sedentary activities (i.e., making phone calls, reading) during an usual working day. This questionnaire has not been tested for validity yet.

Potential confounders: Age, gender, marital status (relationship or single), level of education (low, middle, high education), ethnicity (native or non-native Dutch), and work hours per week were investigated as covariates and potential confounders. Additionally, job demands and supervisor support were assessed on a 4-point scale from "totally agree" to "don't agree" and were derived from the validated Dutch version of the Job Content Questionnaire (JCQ) (44). General health was measured by one item: "In general, how would you state your health condition?" on a 5-point scale, (1=poor to 5=excellent) from the Dutch validated version of the Rand-36 (45). The total scale has shown reasonable validity and satisfactory reliability (α=0.83).

Sample size

The sample size was calculated based on the number of cases needed to indentify an effect on NFR, measured by the NFR after Work scale of the Dutch VBBA questionnaire (36). Previous studies of de Croon et al., (46) and Kuijer et al., (47) showed an effect size of 12 (i.e., within a range from 0-100). Because of randomisation at department

level, a certain loss of efficiency relative to individual randomisation must be considered. For this an intraclass correlation (ICC) of 0.025 was assumed, based on previous studies showing that worksite level ICC's for health-related outcomes are generally small (48-50). The effect size of 12 can be detected by four groups of 101 participants (i.e., taking into account a loss to follow-up of 25%, a power of 80% and a two-tailed significance level of 5%).

Statistical analysis

To evaluate the intervention effects, multilevel analyses were performed for all outcome measures. Four levels were identified: time (two measurements, i.e., 6 months and 12 months), employees (n=365), teamleaders (n=49) and departments (n=19). For each outcome measure, two analyses were executed and both were adjusted for the corresponding baseline outcome measure: (1) crude analyses; (2) adjusted analyses (i.e., adjusted for all potential confounders). All analyses were performed according to the intention-to-treat principle (ITT). P-values of <0.05 were considered to be significant. The measure of the intervention effect was expressed by betas (B) and the 95% confidence intervals were calculated. For the primary outcome measure NFR, an overall intervention effect was analysed and the results at the separate time points (i.e., 6 and 12 months) were provided. For the secondary outcome measures, we focused on the overall intervention effects and when found significant, also the results at the separate time points were given. The multilevel statistical analyses were performed using MLwiN version 2.27.

RESULTS

Participants

Figure 1 presents the flow diagram of the study in which 19 departments of the financial service provider participated. Enrollment of the 412 participants took place between September and December 2011. The randomisation procedure allocated 92 employees (of three departments) to the combined intervention, 118 employees (of seven departments) to the social environmental intervention, 96 employees (of three departments) to the physical environmental intervention and 106 employees (of six

departments) to the control group. Since randomisation was at department level, the groups were not equal in size. Complete follow-up data was obtained for the primary outcome measure, i.e., NFR, from 329 participants (80%). The main reason for loss-to-follow up was changeing to a different employer. For 25 participants, reasons for drop-out were not known.

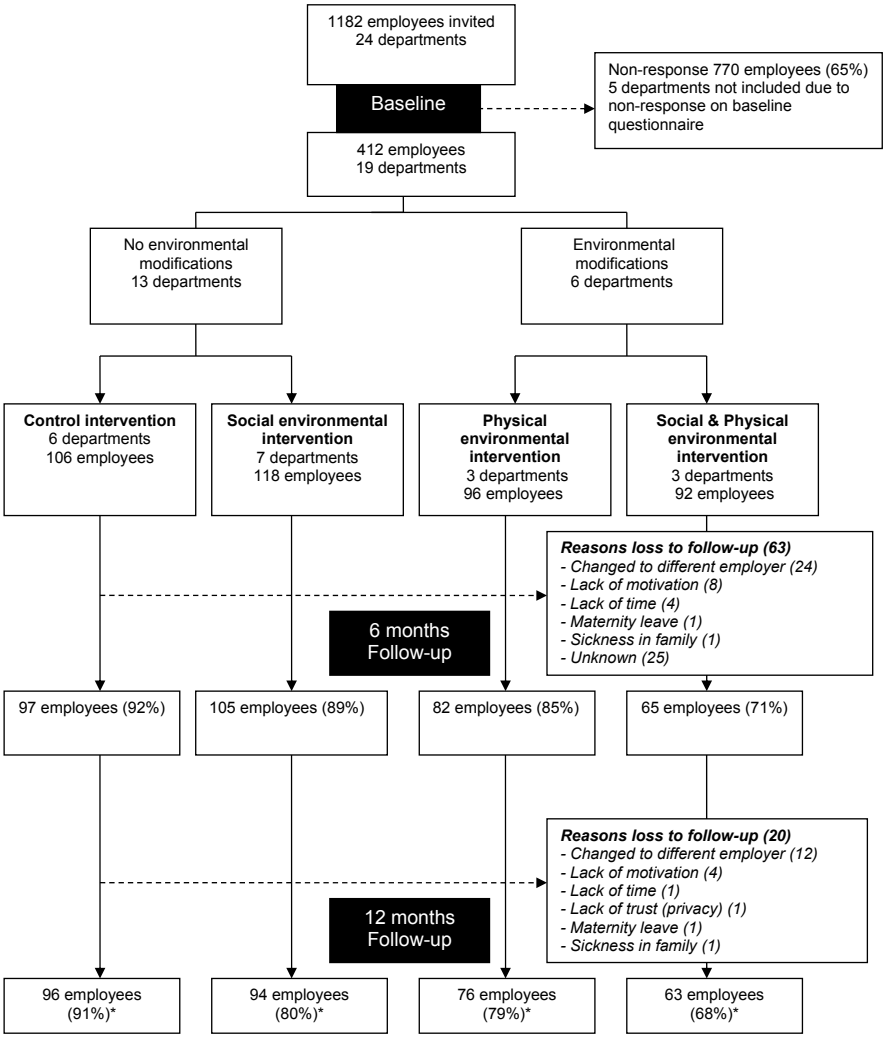

Figure 1. Flow diagram enrollment of participants
*All percentages are count within each group based on the baseline number of employees in that group.

The baseline characteristics of the office employees in the intervention and control groups are given in table 1. No differences regarding age, gender, education, marital status, ethnicity, working hours, general health, job demands and supervisor support were observed between the intervention groups and control group. However, among the participants, males were slightly overrepresented (60%) and the majority was highly educated (57%).

Table 1. Baseline characteristics of the study population

	Social & Physical environmental intervention	Social environmental intervention	Physical environmental intervention	No Intervention (control)
Baseline characteristics	n= 92	n=118	n=96	n=106
Nr of departments	3	7	3	6
Male [n (%)]	51 (55.4)	73 (61.9)	60 (62.5)	65 (61.3)
Age (years) [a]	38.0 (10.5)	43.6 (10.3)	42.2 (10.5)	40.7 (9.2)
Having a partner [n (%)]	74 (80.4)	91 (77.1)	82 (85.4)	85 (80.2)
Dutch nationality [n (%)]	82 (89.1)	106 (89.8)	87 (90.6)	95 (89.6)
Education level [n (%)] Low	17 (18.7)	39 (33.1)	16 (16.7)	21 (19.8)
Intermediate	19 (20.9)	23 (19.5)	20 (20.8)	24 (22.6)
High	55 (60.4)	56 (47.5)	60 (62.5)	61 (57.5)
Working hours per week [a]	35.1 (6.1)	36.9 (4.1)	35.7 (5.6)	36.2 (5.3)
General health (range:1-5) [a]	3.8 (0.9)	3.8 (0.7)	3.8 (0.7)	3.8 (0.7)
Job demands (range:1-5) [a]	2.6 (0.3)	2.7 (0.2)	2.6 (0.3)	2.7 (0.3)
Supervisor support (range:1-5) [a]	2.8 (0.5)	2.9 (0.5)	2.9 (0.4)	2.9 (0.5)

[a]Mean (Standard Deviation); n=number of employees

The means for NFR, exhaustion, detachment, relaxation, small breaks, stair climbing, physical activity and sedentary behaviour at work at baseline and for the follow-up measurements are presented in table 2.

Table 2. Means and standard deviations of all outcome measures for the intervention groups versus the control group at baseline, 6 months and 12 months.

	Social & Physical environmental intervention			Social environmental intervention			Physical environmental intervention			No intervention (control)		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD
NFR (range:0-100)												
Baseline	92	33.3	29.9	118	31.8	28.7	96	33.7	31.3	106	30.4	27.7
6 months	65	29.4	27.2	105	29.7	28.3	82	30.3	29.1	97	31.9	30.1
12 months	63	24.0	24.5	94	28.1	30.3	76	29.3	29.8	96	28.8	29.1
Exhaustion (range:1-4)												
Baseline	92	2.3	0.5	118	2.1	0.5	96	2.1	0.5	106	2.1	0.5
6 months	57	2.2	0.4	95	2.3	0.4	68	2.2	0.5	83	2.3	0.5
12 months	54	2.2	0.4	78	2.1	0.4	65	2.1	0.5	85	2.2	0.5
Detachment at work (range:1-7)												
Baseline	92	3.4	1.4	118	3.5	1.5	95	3.6	1.3	106	3.4	1.4
6 months	53	2.3	1.2	84	2.6	1.5	56	2.7	1.5	79	2.5	1.5
12 months	49	2.4	1.5	74	2.6	1.5	56	2.5	1.3	75	2.6	1.5
Detachment after work (range:1-7)												
Baseline	92	4.7	1.4	118	4.8	1.3	96	4.8	1.4	106	4.8	1.3
6 months	53	3.8	1.2	83	4.0	1.1	56	3.9	1.3	78	3.8	1.4
12 months	49	3.7	1.3	73	4.0	1.2	55	4.0	1.1	75	3.9	1.4
Relaxation at work (range:1-7)												
Baseline	92	3.5	1.3	118	3.5	1.3	95	3.5	1.2	106	3.9	1.4
6 months	53	2.5	1.2	84	2.7	1.4	56	2.9	1.5	79	2.8	1.4
12 months	49	2.5	1.1	74	2.8	1.5	56	2.6	1.2	75	2.9	1.5
Relaxation after work (range:1-7)												
Baseline	92	5.0	1.1	117	5.3	1.0	96	5.2	1.1	106	5.3	1.1
6 months	53	4.0	1.0	83	4.2	1.2	56	4.2	1.1	78	4.1	1.3
12 months	49	4.1	1.0	73	4.3	1.1	55	4.3	1.1	75	4.2	1.3
Small breaks at work (range:0-30)												
Baseline	88	1.5	1.5	116	1.4	1.6	96	1.6	1.6	106	1.6	1.7
6 months	53	2.5	2.1	84	2.5	2.6	57	1.6	1.4	79	1.8	1.9
12 months	48	2.7	2.6	74	2.1	3.6	56	1.5	1.5	75	2.0	2.7

Stair climbing at work (range:0-20)												
Baseline	90	4.1	2.8	108	1.9	1.9	96	3.4	2.4	99	2.5	2.0
6 months	53	4.2	2.9	88	1.8	1.9	59	4.6	3.0	80	2.3	2.2
12 months	49	4.0	2.8	73	1.7	1.8	57	4.0	2.9	78	2.0	1.7
Active commuting (minutes per week)												
Baseline	92	72.4	95.9	118	91.7	130.0	96	82.5	121.0	106	97.5	94.6
6 months	91	373.6	893.8	90	261.2	628.4	86	141.6	281.9	82	263.4	564.5
12 months	63	293.4	788.5	94	145.7	222.2	76	434.1	1235.3	96	152.0	161.8
Leisure activities (minutes per week)												
Baseline	92	343.8	279.1	118	336.5	273.3	96	363.7	297.9	106	422.0	292.8
6 months	91	224.7	314.5	90	304.0	727.9	86	208.9	236.2	82	276.3	285.3
12 months	63	389.8	360.8	94	523.9	898.2	76	449.4	531.6	96	421.6	382.9
Sport activities (minutes per week)												
Baseline	92	173.5	221.8	118	149.8	193.9	96	167.8	180.9	106	188.8	190.4
6 months	65	144.5	230.3	105	147.4	211.6	82	145.5	215.1	97	142.3	220.2
12 months	63	122.6	146.7	94	203.9	501.0	76	145.6	202.7	96	167.5	244.5
Light physical activity (minutes per week)												
Baseline	92	1774.7	1229.0	118	1760.5	1497.4	96	1683.1	1403.4	106	2011.1	1276.8
6 months	91	1788.9	1697.4	90	1448.2	1549.6	86	1481.3	1320.3	82	1539.0	1399.2
12 months	63	1672.8	1551.7	94	1447.0	1575.2	76	1409.4	1659.7	96	1864.0	1657.6
Moderate physical activity (minutes per week)												
Baseline	92	239.5	186.2	118	252.5	243.3	96	263.0	251.4	106	368.2	298.8
6 months	91	263.7	502.0	90	327.5	536.6	86	180.8	208.8	82	240.7	269.4
12 months	63	371.2	687.3	94	357.6	740.9	76	349.8	697.3	96	332.0	397.0
Vigorous physical activity (minutes per week)												
Baseline	92	84.9	205.5	118	87.5	172.6	96	75.2	124.3	106	85.5	128.5
6 months	91	7.3	42.4	90	28.7	97.5	86	48.1	285.8	82	52.3	189.4
12 months	63	75.1	122.5	94	121.6	432.0	76	100.3	174.9	96	94.2	198.9
Sedentary behaviour at work (minutes per day)												
Baseline	92	477.3	166.4	118	472.2	148.8	96	500.8	170.4	106	471.3	149.3
6 months	63	380.6	221.6	100	428.5	215.9	76	359.7	262.1	93	414.6	209.2
12 months	63	378.6	221.8	94	365.8	239.2	76	367.2	249.6	96	403.8	245.2

n=number of employees; M=Mean; SD=Standard Deviation

Intervention effects on NFR

The results on the primary outcome measure of the study, NFR, are presented in table 3. All the intervention groups showed a reduction in NFR. The highest reduction was found in the combined intervention group at 12 months. However, neither the overall intervention effects nor the effects at any time point were significant for NFR.

Table 3. Crude and adjusted overall effects, at 6 months and at 12 months, of NFR between the intervention groups and the control group.

	Social & Physical environmental Intervention			**Social environmental intervention**			**Physical environmental intervention**		
NFR (0-100)	B	95% CI	p-value	B	95% CI	p-value	B	95% CI	p-value
Overall crude	-4.6	-11.3 – 2.0	0.17	-1.9	-7.9 – 4.1	0.53	-3.4	-9.8 – 3.0	0.30
Overall adjusted	-4.8	-11.4 – 1.9	0.16	-1.8	-7.8 – 4.2	0.56	-3.5	-9.8 – 2.9	0.29
6 months crude	-2.6	-9.7 – 4.5	0.48	-1.5	-7.8 – 4.8	0.65	-2.9	-9.6 – 3.8	0.40
6 months adjusted	-2.9	-10.0 – 4.3	0.43	-1.4	-7.7 – 4.9	0.67	-2.8	-9.6 – 3.9	0.41
12 months crude	-6.8	-14.0 – 0.4	0.06	-2.4	- 8.8 – 3.9	0.45	-3.9	-10.8 – 2.9	0.26
12 months adjusted	-6.8	-14.0 – 0.4	0.07	-2.3	-8.7 – 4.2	0.49	-4.2	-11.0 – 2.7	0.23

Adjusted for confounders age, gender, education, marital status, general health, job demands, supervisor support, and corresponding baseline measure of the outcome variable. Significant effects are in bold. A negative Bèta (B) means a lower NFR in the intervention group compared to the control group. [B=Bèta, CI=Confidence Interval, p-value is significant <0.05]

Other intervention effects

For the other outcomes, the overall effects of the interventions are shown in table 4. When found significant at the separate time points (i.e., 6 and 12 months), these effects are presented in table 5.

Table 4. Crude and adjusted overall effects in all secondary outcome measures between the intervention groups and the control group over a 12 months follow-up period.

	Social & Physical environmental Intervention			Social environmental Intervention			Physical environmental Intervention		
	B	95% CI	p-value	B	95% CI	p-value	B	95% CI	p-value
Exhaustion (1-4) Crude	**-0.2**	**-0.3 – -0.1**	**<0.01**	-0.1	-0.1 – 0.0	0.13	-0.1	-0.2 – 0.0	0.16
Adjusted	**-0.2**	**-0.3 – -0.1**	**<0.01**	-0.1	-0.1 – 0.0	0.13	-0.1	-0.2 – 0.0	0.23
Detachment at work (1-7) Crude	-0.1	-0.5 – 0.3	0.58	0.1	-0.3 – 0.4	0.76	0.0	-0.3 – 0.4	0.90
Adjusted	-0.2	-0.5 – 0.2	0.41	0.1	-0.3 – 0.4	0.76	0.1	-0.3 – 0.4	0.77
Detachment after work (1-7) Crude	0.0	-0.3 – 0.3	0.85	0.2	-0.1 – 0.4	0.23	0.2	-0.1 – 0.5	0.29
Adjusted	0.0	-0.3 – 0.3	0.85	0.1	-0.1 – 0.4	0.35	0.2	- 0.1 – 0.5	0.16
Relaxation at work (1-7) Crude	-0.2	-0.6 – 0.1	0.24	0.0	-0.3 – 0.3	0.85	0.1	-0.3 – 0.4	0.68
Adjusted	-0.3	-0.6 – 0.0	0.09	0.1	-0.3 – 0.4	0.70	0.1	-0.3 – 0.4	0.64
Relaxation after work (1-7) Crude	0.1	-0.2 – 0.4	0.52	0.2	-0.1 – 0.4	0.25	0.2	-0.1 – 0.5	0.15
Adjusted	0.1	-0.2 – 0.4	0.55	0.1	-0.1 – 0.4	0.25	0.2	-0.1 – 0.5	0.12
Small breaks at work (0-30) Crude	**0.8**	**0.2 – 1.3**	**<0.01**	0.4	-0.1 – 0.9	0.08	-0.2	-0.7 – 0.3	0.44
Adjusted	**0.8**	**0.3 – 1.3**	**<0.01**	0.4	-0.1 – 0.9	0.08	-0.2	-0.7 – 0.3	0.47
Stair climbing at work (0-20) Crude	0.4	-0.2 – 0.9	0.19	-0.2	-0.7 – 0.3	0.40	**1.0**	**0.5 – 1.5**	**<0.01**
Adjusted	0.5	-0.0 – 1.1	0.05	-0.1	-0.6 – 0.4	0.63	**1.0**	**0.5 – 1.5**	**<0.01**
Active commuting[A] Crude	144.1	-1.5 – 289.6	0.05	2.01	-136.3 – 140.3	0.98	81.2	-62.2 – 224.6	0.27
Adjusted	142.0	-5.5 – 289.4	0.06	-8.3	-150.0 – 133.4	0.91	91.9	-53.8 – 237.5	0.22
Leisure activities[A] Crude	-47.8	-162.4 – 66.7	0.42	71.0	-38.1 – 180.0	0.20	-20.8	-133.6 – 92.0	0.72
Adjusted	-41.5	-155.9 – 72.8	0.48	33.5	-76.9 – 144.0	0.55	-28.0	-141.1 – 85.2	0.63
Sport activities[A] Crude	-18.8	-76.8 – 39.3	0.53	35.5	-16.2 – 87.1	0.18	5.9	-48.8 – 60.6	0.83
Adjusted	-18.9	-77.1 – 39.3	0.52	30.4	-22.0 – 82.7	0.25	3.6	-51.2 – 58.6	0.90
Light physical activity[A] Crude	10.5	-344.8 – 366.0	0.95	-324.0	-660.7 – 12.7	0.06	-211.8	-563.8 – 140.3	0.24
Adjusted	-37.3	-396.8 – 322.2	0.84	-322.5	-665.5 – 20.5	0.07	-217.1	-573.6 – 139.4	0.23
Moderate physical activity[A] Crude	57.7	-5.8 – 173.5	0.32	87.8	-22.2 – 197.8	0.12	6.5	-107.4 – 120.4	0.91
Adjusted	54.8	-58.1 – 171.8	0.36	63.1	-48.9 – 175.2	0.27	6.8	-108.1 – 121.7	0.90
Vigorous physical activity[A] Crude	-42.2	-91.1 – 6.8	0.09	-1.4	-48.0 – 45.3	0.51	-0.2	-48.4 – 48.0	0.99
Adjusted	-38.5	-88.0 – 11.0	0.13	-11.6	-59.3 – 36.2	0.64	-4.6	-53.2 – 44.0	0.86
Sedentary behaviour at work[B] Crude	-33.9	-90.6 – 22.9	0.24	-16.9	-67.4 – 33.7	0.52	**-54.6**	**-108.6 – -0.5**	**0.048**
Adjusted	-33.8	-90.3 – 22.7	0.24	-29.8	-80.3 – 20.8	0.29	**-57.9**	**-111.7 – -4.2**	**0.03**

[A]minutes per week, [B]minutes per day. Adjusted for confounders age, gender, education, marital status, general health, job demands, supervisor support, and corresponding baseline measure of the outcome variable. Significant effects are in bold;. A negative Bèta (B) means less exhaustion, detachment and relaxation at work and after work, small breaks, stair climbing, active commuting, leisure activities, sports, light physical activity, moderate physical activity, vigorous physical activity and sedentary behaviour in the intervention group compared to the control group. [B=Bèta, CI=Confidence Interval, p-value is significant <0.05]

Table 5. Crude and adjusted effects on exhaustion, small breaks, stair climbing, active commuting, leisure activities, sport activities, vigorous physical activity, sedentary behaviour at work between the intervention groups and control group found significant at 6 and/or 12 months follow-up.

	Social & Physical environmental intervention			Social environmental Intervention			Physical environmental Intervention		
	B	95% CI	p-value	B	95% CI	p-value	B	95% CI	p-value
Exhaustion (1-4) 6 months crude	**-0.2**	**-0.0 – -0.3**	**<0.01**	-0.0	-0.1 – 0.1	0.97	-0.0	-0.1 – 0.1	0.5
6 months adjusted	**-0.2**	**-0.0 – -0.3**	**<0.01**	0.0	-0.1 – 0.1	0.99	-0.0	-0.1 – 0.1	0.5
12 months crude	**-0.2**	**-0.1 – -0.3**	**<0.01**	**-0.1**	**-0.2 – -0.0**	**<0.01**	-0.1	-0.2 – 0.0	0.06
12 months adjusted	**-0.2**	**0.1 – 1.3**	**<0.01**	**-0.1**	**-0.2 – -0.0**	**<0.01**	-0.1	-0.2 – 0.0	0.06
Small Breaks at work (0-30) 6 months crude	**0.7**	**0.1 – 1.3**	**0.02**	**0.7**	**0.2 – 1.2**	**<0.01**	-0.1	-0.6 – 0.5	0.84
6 months adjusted	**0.8**	**0.1 – 1.4**	**0.02**	**0.7**	**0.2 – 1.2**	**<0.01**	-0.1	-0.7 – 0.5	0.74
12 months crude	**0.8**	**0.1 – 1.4**	**0.01**	0.1	-0.4 – 0.7	0.67	-0.3	-0.9 – 0.2	0.26
12 months adjusted	**0.8**	**0.2 – 1.5**	**0.01**	0.1	-0.4 – 0.6	0.72	-0.3	-0.9 – 0.3	0.38
Stair climbing at work (0-20) 6 months crude	0.4	-0.2 – 1.0	0.19	-0.1	-0.7 – 0.4	0.63	**1.3**	**0.7 – 1.8**	**<0.01**
6 months adjusted	0.6	-0.0 – 1.2	0.07	-0.0	-0.6 – 0.5	0.94	**1.3**	**0.7 – 1.8**	**<0.01**
12 months crude	0.3	-0.3 – 1.0	0.32	-0.3	-0.9 – 0.2	0.25	**0.7**	**0.1 – 1.3**	**0.02**
12 months adjusted	0.5	-0.1 – 1.1	0.13	-0.2	-0.8 – 0.3	0.41	**0.8**	**0.2 – 1.3**	**0.01**
Active commuting [A] 6 months crude	**177.2**	**8.2 – 346.1**	**0.04**	60.0	-108.5 – 228.6	0.48	-55.3	-227.2 – 116.6	0.53
6 months adjusted	**175.1**	**4.3 – 346.0**	**<0.05**	50.1	-121.3 – 221.5	0.57	-52.8	-227.3 – 121.8	0.56
12 months crude	96.9	-95.1 – 288.8	0.32	-53.5	-219.5 – 112.6	0.53	**234.1**	**55.4 – 412.8**	**0.01**
12 months adjusted	98.1	-95.9 – 292.2	0.32	-66.3	-236.1 – 103.5	0.45	**252.1**	**71.0 – 433.3**	**<0.01**
Leisure activities [A] 6 months crude	49.4	-100.4 – 199.1	0.52	**180.9**	**60.0 – 310.8**	**<0.01**	106.9	-32.4 – 246.3	0.13
6 months adjusted	48.2	-101.5 – 198.0	0.53	**132.9**	**1.4 – 264.4**	**<0.05**	48.2	-101.5 – 198.0	0.53
Sport activities [A] 12 months crude	-32.7	-103.5 – 38.0	0.36	**65.8**	**4.2 – 127.4**	**0.04**	5.0	-61.1 – 71.0	0.88
12 months adjusted	-33.7	-104.9 – 37.6	0.35	59.9	-2.7 – 122.5	0.06	1.4	-65.2 – 67.9	0.73
Vigorous physical activity[A] 6 months crude	**-64.9**	**-123.3 – -6.5**	**0.03**	-43.4	-101.6 – 15.1	0.14	-24.3	-84.3 – 35.9	0.43
6 months adjusted	**-62.6**	**-120.9 – -3.9**	**0.03**	-53.6	-111.3 – 4.1	0.07	-30.5	-89.2 – 28.2	0.31
Sedentary behaviour at work[B] 12 months crude	-36.1	-103.6 – 31.4	0.29	-50.1	-108.8 – 8.7	0.10	-53.5	-116.7 – 9.7	0.10
12 months adjusted	-36.0	-103.3 – 31.3	0.29	**-66.2**	**-125.4 – -7.0**	**0.03**	-61.4	-124.5 – 1.7	0.06

[A]minutes per week, [B]minutes per day. Adjusted for confounders age, gender, education, marital status, general health, job demands, supervisor support, and corresponding baseline measure of the outcome variable. Significant effects are in bold. A negative Bèta (B) means less exhaustion, small breaks, stair climbing, active commuting, leisure activities, sport activities, vigorous physical activity, sedentary behaviour in the intervention group compared to the control group. [B=Bèta, CI=Confidence Interval, p-value is significant <0.05]

The interventions did neither result in any significant effects for detachment and relaxation at work and after work, nor for light and moderate intensity physical activity. In the following paragraph, the significant results are depicted.
The combined environmental intervention group was associated with an overall lower level of exhaustion and a higher frequency of small breaks at work, which was persistent at both 6 and 12 month follow-up. At 6 months, an increase in active commuting and a reduction in vigorous physical activity were shown. The social environmental intervention group showed an increase in frequency of small breaks at work and in leisure activities at 6 months. At 12 months, a lower level of exhaustion and a reduction in sedentary behaviour at work was found. In the physical environmental intervention group, an overall increase in stair climbing at work was found, which was persistent at both 6 and 12 months follow-up. Moreover, an overall reduction in sedentary behaviour at work was found, but no effects were found at the two respective follow-up moments. Furthermore, an increase in active commuting was found at 12 months.

DISCUSSION

The results of this study showed that none of the interventions was effective in improving the NFR among office workers compared to the control group. Nevertheless, all outcomes changed into the expected, favourable direction. We did find statistically significant, but small, decreases in exhaustion, vigorous physical activity and sedentary behaviour at work, and statistically significant increases in small breaks at work, active commuting, stair climbing at work, and leisure activities.

Need for recovery (NFR)

Based on the literature, it was hypothesized that our combined social and physical environmental intervention would be effective in improving the NFR. Our findings did not confirm this hypothesis. Although literature on this topic is scarce, this result is in line with two recent other studies: one among construction workers (i.e., empowerment training and training guided by a physical therapist) (51), and another among employees of two Dutch research institutes (mindfulness intervention)

(52). Even more scarce are studies involving the effect of changes in the physical environment on NFR. Only one study was found of Meijer et al., (53), where the effects of a so-called innovative office concept (e.g., open-office plan and flexible workplaces) on NFR among Dutch office employees was studied. They found no significant improvements in NFR at 15 months follow-up (53).

The present study used a primary preventive approach. This means that efforts were directed at a healthy population, instead of a population with mental or physical health problems (54). A downside of employing primary prevention (i.e., population strategy) is that it may offer relatively small health benefits (i.e., baseline values are generally favourable) and less motivated subjects (55). The participants of our study had positive baseline values on NFR (M=33.2, SD=29.3), compared to average norm scores (M=38.1) (2). A possible explanation for this finding might be that employees with healthy lifestyles are more likely to participate, because they are more motivated to pursue and maintain their good health (56). Due to these positive baseline values, a significant decline in NFR as a result of the intervention is difficult to obtain (i.e., bottom effects). To have larger effects, efforts should be directed at a selection of participants with a high NFR.

Exhaustion

Exhaustion was measured using the OLdenburg Burnout Inventory (OLBI) (37). However, information about norm scores of this scale is unknown. Baseline values for exhaustion were generally low in all intervention groups and the control group. Nevertheless, in the combined intervention group, we did find a significant reduction, which was present both at 6 months and at 12 months. And in the social environmental intervention group, a significant reduction at 12 months was found. A study among healthcare workers, recruited on the basis of a high level of exhaustion, found that peer-support groups could be helpful in reducing levels of exhaustion, stress and minimizing work-family conflict (57). This offers a possible explanation for the reduction in exhaustion in the combined and social environmental intervention group, because both teamleaders and colleagues had an active role in stimulating and supporting each other. No such a reduction of exhaustion was found in the physical environmental intervention group.

Detachment, relaxation and small breaks at work

With respect to detachment and relaxation, no effects were found. Although mental separation through detachment or relaxation has attracted attention, because it is helpful in improving job performance (58) and well-being (59), it is not very often considered in WHP programs. Understanding the particular activities people execute for detachment and relaxation, and their interrelationships at work and after work, is important for future intervention development. Further, it could be that employees did not feel legitimized to detach or relax during work hours, which could explain that no effects were found on detachment and relaxation. Also, alongside the present trial, a study was executed assessing the measurement properties of the detachment and relaxation scale. The results showed that the scale was internally consistent, reliable and had moderate construct validity (39). The lack of effect might be explained by the fact that unsatisfactory responsiveness was demonstrated (39). Therefore, conclusions on detachment and relaxation based on our present results must be drawn with care.

We did find improvements in the frequency of small breaks at work in the combined intervention group at both time points, and in the social environmental intervention group at 6 months. As the short-term benefits of within workday breaks are restorative, refreshing and energizing (60), our results are valuable for future research. So far, few RCTs have been done which investigated the effectiveness of WHP programs on small breaks. Only in the area of work recovery, one study showed that enjoyable and restful within workday breaks improved the recovery in a group of service employees (61).

Daily physical activity

A higher amount of active commuting and a reduction in vigorous physical activity at 6 months was found in the combined intervention group. In the social environmental intervention group, the amount of time spent in leisure activities at 6 months was increased. The physical environmental intervention showed an increase in stair climbing and active commuting at 6 and 12 months. We found no intervention effects on total minutes in light and moderate physical activity per week. The lack of effects in our study on physical activity after work may be related to the fact that the main

focus was on stimulating physical activity at work. Therefore, no large changes in physical activity after work were expected. Since most vigorous physical activity takes place in leisure time, it is not surprising that we did not find improvements on vigorous physical activity during work hours. We did find an unexpected significant reduction in vigorous physical activity at 6 months in the combined intervention group. Since we did not focus on vigorous physical activity in particular, it is possible that participants focussed on light to moderate physical activity, therewith reducing their focus on vigorous physical activity.

Sedentary behaviour at work

Furthermore, a reduction of sedentary behaviour was shown in the social environmental intervention group and in the physical environmental intervention group, but not in the combined group. Previous studies have shown that high amounts of sedentary behaviour increases the risk of morbidity and mortality, irrespective of whether people engage in moderate to vigorous intensity activities frequently (62;63). Because sedentary behaviour at work was assessed with a questionnaire that was not validated, our results should be interpreted with caution.

Strengths and limitations

A strength of our study is our study design, in which we applied a 2x2 factorial design in which we could randomise the social environmental intervention and stratify the physical environmental intervention. This enabled us to simultaneously study the effectiveness of the combined, and the social and the physical environmental interventions separately. Another strength is the minimized risk of contamination due to randomisation at department level. Moreover, during all analyses, the multilevel procedure was applied. With multilevel analyses, incompleteness of the data is taken into account (i.e., method of maximum likelihood), and imputation of missing data is thus not necessary (64). The loss-to- follow up at 6 months for the secondary outcome measures (>20%) was considerable, which is a common problem in intervention studies (65). However, there were no significant differences at baseline between non-responders and responders, and therefore it is unlikely that self-selection of participants has influenced our study results.

Some considerations should be given to the measurement properties of the questionnaires used. One issue concerns recall bias in measuring small breaks or detachment/relaxation, because previous research indicated that strenuous activities are more easily recalled than light activities (66). Also, previous research showed that self-reported stair use was systematically overestimated (67) and self-reported physical activity levels proved to show less accurate information on actual physical activity levels than objectively measured physical activity using accelerometry (68).
Unfortunately, the present study was underpowered regarding the primary outcome measure NFR. Although our total sample size was sufficient, our smallest intervention group contained 63 instead of the anticipated 76 participants due to a loss-to-follow up at 6 months (29%) and at 12 months (32%). This may have contributed to the fact that we did not find a significant effect on NFR in the combined intervention group.
Finally, although many statistical tests were performed, we did not perform an adjustment for multiple testing. The reason for not doing this was that we were not interested in single significant results, but in the broader picture. Because of multiple testing, single significant results should be interpreted with caution.

Research and practical implications

We believe that the combined social and physical environmental intervention has the potential to improve the NFR. The present study consisted of a general healthy and well-functioning population, which makes it hard to have a large impact on improving the NFR. It is therefore recommended to implement the social and physical environmental intervention among a population with higher baseline values on NFR. Further, we made use of a minimal intervention strategy for the GMI-intervention, i.e., a two-day training in GMI, and only four GMI-sessions with the team, due to the restricted time available of both teamleaders and employees. The intensity of the intervention may not have been sufficient to sort effect. A more intensive intervention (e.g., weekly sessions, exercise schemes) might be needed to enhance effects. Though more extensive programming may challenge feasibility in the work setting. Also, integration of the social media platform by means of designing a strategic plan, incentives for regular use and linking to other platforms such as facebook is recommended. Additionally, it could be that the relatively 'simple' (e.g.,

placing signs to enhance stair use) environmental modifications did not sort sufficient effect and more 'elaborated' environmental modifications should be implemented.
The strongest non-significant reduction for NFR was found in the combined intervention group, which is in line with the socio-ecological approach (34). For the other outcomes, the combined intervention did not result in the strongest effects and hardly any overlap in effects was found with the separate social and physical environmental intervention. Further, the interventions mainly seemed to have an effect on physical activity related outcomes (i.e., stair climbing, active commuting, sedentary behaviour at work, and leisure activities). Possibly, the participating financial service provider supported physical activity more as they had a recently opened company fitness center. Also, attention should be paid to a reliable, valid and responsive questionnaire for measuring detachment and relaxation. Another recommendation is that objective measurements should be added to assess small breaks at work, stair climbing at work, physical activity and sedentary behaviour at work, because self-reports are subject to measurement error.

Conclusion

Strong conclusions about the combined intervention's effectiveness in improving the NFR cannot be made, as we did not find significant effects of our interventions on NFR. It is recommended to investigate the effectiveness of our interventions in a population with a higher NFR.

REFERENCES

(1) EU-OSHA. European agency for safety and health at work. European Survey on new and emerging risk. available at: https://osha.europa.eu/nl/topics/stress

(2) Jansen NWH, Kant I, Van den Brandt PA. Need for recovery in the working population: description and associations with fatigue and psychological distress. Int J Behav Med. 2002;4:322-40.

(3) The Netherlands working conditions survey (national enquete arbeidsomstandigheden, NEA). 2005.

(4) Van Veldhoven M. Need for recovery after work. An overview of construct, measurement and research. In: Houdmont J, Leka S, editors. Occupational health psychology. European perspectives on research, education and practice. Nottingham: Nottingham University Press; 2008.

(5) Geurts SA, Sonnentag S. Recovery as an explanatory mechanism in the relation between acute stress reactions and chronic health impairment. Scan J Work Environ Health. 2006;32:482-92.

(6) Meijman T, Mulder G. Psychological aspects of workload. In: Drenth P, Thierry H, editors. Handbook of work and organizational psychology. Hove, England: Psychology; 2012. p. 5-33.

(7) Sluiter JK, Van der Beek AJ, Frings-Dresen MHW. The influence of work characteristics on the need for recovery and experienced health: A study on coach drivers. Ergonomics. 1999;42:573-83.

(8) van Hooff ML, Geurts SA, Kompier MA, Taris TW. Workdays, in-between workdays and the weekend: a diary study on effort and recovery. Int Arch Occup Environ Health. 2007;80:599-613.

(9) de Croon EM, Sluiter JK, Frings-Dresen MH. Need for recovery after works predicts sickness absence: a 2-year prospective cohort study in truck drivers. J Psychosom Res. 2003;55:331-9.

(10) ILO. Guidelines on occupational safety and health management systems. Geneva: International Labour office; 2001.

(11) Conn VS, Hafdahl AR, Cooper PS, Brown LM, Lusk SL. Meta-analysis of workplace physical activity interventions. Am J Prev Med. 2009;37:330-9.

(12) Hutchinson AD, Wilson C. Improving nutrition and physical activity in the workplace: a meta-analysis of intervention studies. Health Promot Int. 2012;27:238-49.

(13) Maes L, Van Cauwenberghe E, Van Lippenvelde W, Spittaels H, De Pauw E, Oppert JM, et al. Effectiveness of workplace health promotion in Europe promoting healthy eating: a systematic review. Eur J Public Health. 2012;22:677-83.

(14) Malik SH, Blake H, Suggs LS. A systematic review of workplace health promotion interventions for increasing physical activity. Br J Health Psychol. 2013;Epub ahead of print.

(15) Ni Mhurchu C, Aston LM, Jebb SA. Effects of worksite health promotion interventions on employee diets: a systematic review. BMC Public Health. 2010;10:1-7.

(16) Proper KI, Koning M, Van der Beek AJ, Hildebrandt VH, Bosscher RJ, van Mechelen W. The effectiveness of worksite physical activity programs on physical activity, physical fitness, and health. Clin J Sport Med. 2003;13:106-17.

(17) Vuillemin A, Rostami C, Maes L, Van Cauwenberghe E, Van Lenthe FJ, Brug J, et al. Worksite physical activity interventions and obesity: a review of European studies (the HOPE project). Obes Facts 2011;4:479-88.

(18) Strijk JE, Proper KI, Van der Beek AJ, Van Mechelen M. A worksite vitality intervention to improve older workers' lifestyle and vitality-related outcomes. Results of a randomized controlled trial. J Epidemiol Community Health. 2012;66:1071-80.

(19) Rook JW, Zijlstra FRH. The contribution of various types of activities to recovery. European Journal of Work and Organizational Psychology. 2006;15:218-40.

(20) Siltaloppi M, Kinnunen U, Feldt T, Tolvanen A. Development of need for recovery from work over one year: a person-centered approach. Anxiety, Stress & Coping. 2012;25:23-42.

(21) Sonnentag S. Work, recovery activities, and individual well-being: a diary study. J Occup Health Psychol. 2001;6:196-210.

(22) Sonnentag S, Natter E. Flight attendants' daily recovery from work: Is there no place like home? International Journal of Stress Management. 2004;11:366-91.

(23) Norris R, Carroll D, Cochrane R. The effects of aerobic and anaerobic training on fitness, blood pressure, and psychological stress and well-being. J Psychosom Res. 1990;34:367-75.

(24) Sonnentag S, Fritz C. The Recovery Experience Questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. J Occup Health Psychol. 2007;12:204-221.

(25) Hahn VV, Binnewies C, Sonnentag S, Mozja EJ. Learning how To recover from job stress: Effects of a recovery training program on recovery, recovery-related self-efficacy, and well-being. J Occup Health Psychol. 2011;16:202-16.

(26) Binnewies C, Sonnentag S, Mozja EJ. Recovery during the weekend and fluctuations in weekly job performance: a week-level study examining intra-individual relationships. Journal of Occupational and Organizational Psychology. 2010;83:419-41.

(27) van Hooff ML. The daily commute from work to home: examining employees' experiences in relation to their recovery status. Stress & Health. 2013. Epub ahead of print.

(28) Green LW, Richard L, Potvin L. Ecological foundations of health promotion. Am J Health Promot. 1996;10:270-81.

(29) McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. Health Educ Q. 1988;15:351-77.

(30) Robinson T. Applying the socio-ecological model to improving fruit and vegetable intake among low-income African-Americans. J Community Health. 2008;33:395-406.

(31) Stokols D. Translating social ecological theory into guidelines for community health promotion. Am J Health Promot. 1996;10:282-98.

(32) Townsend N, Foster C. Developing and applying a socio-ecological model to the promotion of healthy eating in the school. Public Health Nutr. 2013;16:1101-8.

(33) Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJF, Martin BW. Correlates of physical activity: why are some people physically active and others not? Lancet. 2012;380:258-71.

(34) Richard L, Gauvin L, Raine K. Ecological models revisited: their uses and evaluation in health promotion over two decades. Annu Rev Public Health. 2011;32:307-26.

(35) Coffeng JK, Hendriksen IJM, Duijts SF, Proper KI, van Mechelen W, Boot CRL. The development of the Be Active & Relax 'Vitality in Practice' (VIP) project and design of an RCT to reduce the need for recovery in office employees. BMC Public Health. 2012;12:592-617.

(36) Van Veldhoven M, Broersen S. Measurement quality and validity of the "need for recovery scale. Occup Environ Med. 2003;60:3-9.

(37) Demerouti E, Bakker AB, Vardakou I, Kantas A. The convergent validity of two burnout instruments: A multitrait-multimethod analysis. European Journal of Psychological Assessment. 2003;19:12-23.

(38) Demerouti E, Bakker AB. The Oldenburg Burnout Inventory: a good alternative to measure burnout and engagement. Handbook of stress and burnout in health care.NY: Nova Science: Hauppauge; 2008.

(39) Coffeng JK, Hendriksen IJM, Terwee CB, van Mechelen W, Boot CRL. Assessment of reliability, validity and responsiveness of the Detachment And Relaxation scale. submitted for review 2014.

(40) Wendel-Vos GC, Schuit AJ, Saris WH, Kromhout D. Reproducibility and relative validity of the Short Questionnaire to Assess Health-enhancing physical activity. J Clin Epidemiol. 2003;56:1163-9.

(41) van Poppel MN, Chinapaw MJ, Mokkink LB, van Mechelen W, Terwee CB. Physical activity questionnaires for adults: a systematic review of measurement properties. Sports Med. 2010;40:565-600.

(42) Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, et al. Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc. 2000;32:S498-504.

(43) Sedentary Behaviour Research Network. Standardized use of the terms "sedentary" and "sedentary behaviors". Appl Physiol Nutr Metab. 2012;37:540-2.

(44) Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. J Occup Health Psychol. 1998;3:322-55.

(45) Van der Zee K, Sanderman R. Het meten van gezondheidstoestand met de RAND-36: een handleiding (Measurement of health condition with the RAND-36: a guideline). Groningen: Noordelijk Centrum voor Gezondheidsvraagstukken: 1993.

(46) De Croon EM, Sluiter JK, Frings-Dresen MH. Psychometric properties of the Need for Recovery after work scale: test-retest reliability and sensitivity to detect change. Occup Environ Med. 2006;63:202-6.

(47) Kuijer PP, Van der Beek AJ, Van Dieen J, Visser B, Frings-Dresen MH. Effect of job rotation on need for recovery, musculoskeletal complaints, and sick leave due to musculoskeletal complaints: A prospective study among refuse collectors. Am J Ind Med. 2005;47:394-402.

(48) Kelder SH, Jacobs DR, Jeffery RW, McGovern PG, Forster JL. The worksite component of variance: design effects and the Healthy Worker Project. Health Educ Res. 1993;8:555-66.

(49) Martinson BC, Murray DM, Jeffery RW, Henrikus DJ. Intraclass correlation for measures from a worksite health promotion study: Estimates, correlates and applications. Am J Health Promot.1999;13:347-57.

(50) Murray DM, Blitstein JL. Methods to reduce the impact of intraclass correlation in group-randomized trials. Eval Rev. 2003;27:79-103.

(51) Oude Hengel KM, Blatter BM, Joling CI, Van der Beek AJ, Bongers PM. Effectiveness of an intervention at construction worksites on work-engagement, social support, physical workload and need for recovery: results from a cluster randomized controlled trial. BMC Public Health. 2012;12:1008-18.

(52) van Berkel J, Boot CRL, Proper KI, Bongers PM, Van der Beek AJ. Effectiveness of a worksite mindfulness related multi-component health promotion intervention on work engagement and mental health: results of a randomized controlled trial. PloS One 2014;9.

(53) Meijer EM, Frings-Dresen MH, Sluiter JK. Effects of office innovation on office workers' health and performance. Ergonomics. 2009;52:1027-38.

(54) Goetzel RZ, Jacobsen BH, Aldana SG, Vardell K, Yee L. Health care costs of worksite health promotion participants and nonparticipants. J Occup Environ Med 1998;40:341-6.

(55) Rose G. Sick individuals and sick populations. Int J Epidemiol. 2001;30:427-432.

(56) van Dongen JM, van Poppel MNM, Milder IEJ, van Oers HAM, Brug J. Exploring the reach and program use of hello world, an email based health promotion program for pregnant women in the Netherlands. BMC Res Notes. 2012;5:514.

(57) Peterson U, Bergstrom G, Samuelsson M, Asberg M, Nygren A. Reflecting peer-support groups in the prevention of stress and burnout: randomized controlled trial. J Adv Nurs. 2008;63:506-16.

(58) Fritz C, Sonnentag S. Recovery, health, and job performance: Effects of weekend experiences. J Occup Health Psychol. 2005;10:187-99.

(59) Sonnentag S, Binnewies C, Mojza EJ. "Did you have a nice evening?" A day-level study on recovery experiences, sleep, and affect. J Appl Psychol. 2008;93:674-84.

(60) Taylor WC. Transforming work breaks to promote health. Am J Prev Med. 2005;29:461-5.

(61) Trougakos JP, Beal DJ, Green SG, Weiss HM. Making the break count: An episodic examination of recovery activities, emotional experiences, and affective delivery. Academy of Management Journal. 2008;51:131-46.

(62) Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. Med Sci Sports Exerc. 2009;41:998-1005.

(63) Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviors and subsequent health outcomes in adults: a systematic review of longitudinal studies, 1996-2011. Am J Prev Med. 2011;41:207-15.

(64) Von Hippel PT. Regression with missing ys: an improved strategy for analyzing multiply imputed data. Sociological Methodology. 2007;37:83-117.

(65) Galea S, Tracy M. Participation rates in epidemiological studies. Ann Epidemiol. 2007;17:643-53.

(66) Jacobs DR, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. Med Sci Sports Exerc 1993;25:81-91.

(67) Engbers LH, van Poppel MN, van Mechelen W. Measuring stair use in two office building: a comparison between an objective and a self-reported method. Scan J Med Sci Sports. 2007;17:165-71.

(68) Kwak L, Kremers SP, Brug J, van Baak MA. Measuring physical activity in field studies: comparison of a questionnaire, 24-hour recall and an accelerometer. European Journal of Sport Science 2007;7:193-201.